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(71) Applicant(s)
Merck Patent GmbH

(Incorporated in the Federal Republic of Germany)

Frankfurter Strasse 250, D-6100 Darmstadt 1,
Federal Republic of Germany

(72) Inventor(s)

John William Brown
Derek Thomas Hurst
Jaqueline Patricia O'Donovan
David Coates
Simon Greenfield
Mark John Goulding
George William Gray

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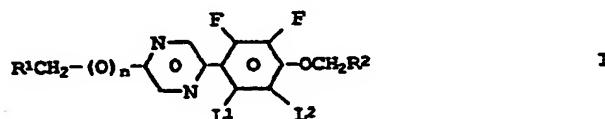
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None

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(74) Agent and/or Address for Service
Venner Shipley & Co
20 Little Britain, LONDON, EC1A 7DH,
United Kingdom

(54) Liquid crystalline di-, tri- and tetra-fluorinated phenylpyrazines

(57) Phenylpyrazine derivatives of the formula I,



[wherein
R¹ and R²

are in each case independently of each other, an unsubstituted alkyl or alkenyl radical or an alkyl or alkenyl radical substituted by one or more halogen or CN atoms having up to 15 C atoms, wherein one or two non-adjacent CH₂ groups can also be replaced by -O- and/or -CO-groups and/or -O-CO-groups and/or -CO-O-groups and/or CH-halogen groups,

n 0 or 1, and

L¹ and L² are each independently of one another H or F,
are suitable as components of liquid-crystalline phases.

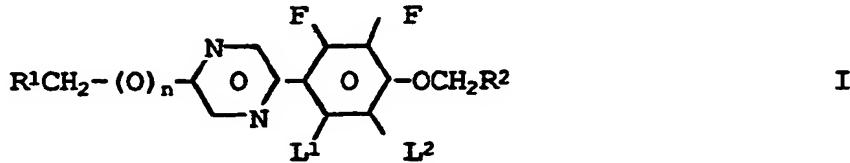
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Phenylpyrazine derivatives

The invention relates to phenylpyrazine derivatives of the
10 formula I,

15



wherein

R¹ and R² are in each case independently of each other, an
unsubstituted alkyl or alkenyl radical or an
alkyl or alkenyl radical substituted by one or
more halogen or CN atoms having up to 15 C atoms,
wherein one or two non-adjacent CH₂ groups can
also be replaced by -O- and/or -CO-groups and/or
-O-CO-groups and/or -CO-O-groups and/or -CH-halo-
gen groups,

n 0 or 1, and

L¹ and L² are each independently of one another H or F.

30

The invention furthermore relates to liquid-crystalline phases containing compounds of the formula I, the use thereof as components of liquid-crystalline phases, and electrooptical display elements which contain phases of this type.

5

The compounds of the formula I can be used as components of liquid-crystalline phases, in particular for displays based on the principle of the twisted cell, the guest-host effect, the effect of deformation of aligned phases or the effect of 10 dynamic scattering.

10

The compounds of the formula I are distinguished by a clearly negative anisotropy of the dielectric constant and, in an electrical anisotropy of the dielectric constant and, in an 15 electrical field, are aligned with their longitudinal molecular axes perpendicular to the field direction.

15

This effect is known and is utilized to control the optical transparency in various liquid-crystal displays, for example 20 in liquid-crystal cells of the light-scattering type (dynamic scattering) of the so-called DAP type (deformation of aligned phases) or ECB type (electrically controlled birefringence) or of the guest/host type (guest/host interaction).

20

25 In addition, compounds of the formula I are suitable as components of chiral tilted smectic phases. Chiral tilted smectic liquid-crystalline phases having ferroelectric prop-

30

erties can be prepared by adding a suitable chiral dope to base mixtures containing one or more tilted smectic phases (L.A. Veresnev et al., Mol. Cryst. Liq. Cryst. 89, 327 (1982); H.R. Brand et al., J. Physique 44 (lett.), L-771 (1983)). Such phases can be used as dielectrics for rapidly switching displays based on the principle, described by Clark and Lagerwall, of SSFLC technology (N.A. Clark and S.T. Lagerwall, Appl. Phys. Lett 36, 899 (1980); US Patent 4,367,924) on the basis of the ferroelectric properties of the chiral tilted phase.

A number of liquid-crystalline compounds having slightly negative dielectric anisotropy have hitherto already been synthesized. In contrast, only relatively few liquid-crystal components having a large negative anisotropy of the dielectric constant are known. In addition, the latter generally have disadvantages, such as, for example, poor solubility in mixtures, high viscosity, high melting points and chemical instability. There is therefore a demand for further compounds having negative dielectric anisotropy which permit the properties of mixtures to be further improved for a very wide variety of electrooptical applications.

US 4,913,837 gives a broad formula covering the compounds claimed here. However, no individual compounds of the formula according to the invention are mentioned. Those skilled in the art would thus be able neither to deduce in simple manner from the prior art possible syntheses for the compounds claimed nor to recognize that the compounds according to the invention have mesophase regions which are predominantly in a

favorable location and are distinguished by a large negative anisotropy of the dielectricity with at the same time low viscosity.

- 5 Neither is there any indication of possibility using the compounds according to the invention in displays based on SSFLC technology, since the compounds claimed therein have low smectic tendencies.
- 10 The invention had the object of indicating stable, liquid-crystalline or mesogenic compounds having a large negative anisotropy of the dielectricity and simultaneously low viscosity.
- 15 It has been found that the compounds of the formula I are preeminently suitable as components of liquid-crystalline phases. They can be used, in particular, to prepare stable liquid-crystalline phases having a broad mesophase range and comparatively low viscosity.
- 20 The compounds of the formula I are furthermore suitable as components of chiral tilted smectic liquid-crystalline phases.
- 25 In addition, the provision of the compounds of the formula I very generally considerably broadens the range of liquid-crystalline substances which are suitable, from various applicational points of view, for the purpose of preparing liquid-crystalline mixtures.

30

The compounds of the formula I have a broad field of application. Depending on the choice of substituents, these compounds can be used as base materials from which liquid-crystalline phases are predominantly composed; however, it is
5 also possible to add liquid-crystalline base materials from other classes of compounds to the compounds of the formula I in order, for example, to vary the dielectric and/or optical anisotropy and/or viscosity and/or the spontaneous polarization and/or the phase ranges and/or the tilt angle and/or the
10 pitch of a dielectric of this type.

The compounds of the formula I are furthermore suitable as intermediates for the preparation of other substances which can be used as components of liquid-crystalline dielectrics.
15

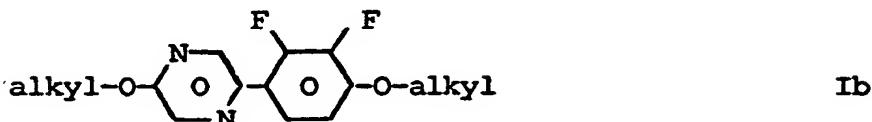
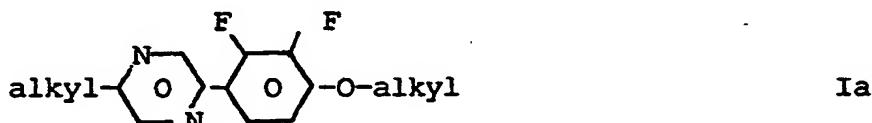
In the pure state, the compounds of the formula I are colorless and form liquid-crystalline mesophases in a temperature range in a favorable location for electrooptical use. They are very stable chemically, thermally and to light.
20

The invention thus relates to the compounds of the formula I.

The invention additionally relates to the use of the compounds of the formula I as components of liquid-crystalline phases. The invention furthermore relates to liquid-crystalline phases containing at least one compound of the formula I, and to liquid-crystal display elements containing such phases. Phases of this type have particularly advantageous elastic constants, and, due to their low $\Delta\epsilon/\epsilon_0$ values, are
25 particularly suitable for TFT mixtures.
30

Above and below R¹, R² and n are as defined, unless expressly stated otherwise.

Accordingly, the compounds of the formula I include compounds of the sub-formulae Ia to Ib:



In the compounds of the formulae above and below, R¹ and R² preferably have 2-12 C atoms, in particular 3-10 C atoms. It is also possible for one or two CH₂ groups in R¹ and R² to have been replaced. It is preferred that only one CH₂ group has been replaced, by -O- or -CH=CH-.

20

In the formulae above and below R¹ and R² are preferably alkyl, alkoxy or another oxaalkyl group, furthermore also alkyl groups in which one or two CH₂ groups may be replaced by -CH=CH-.

25

If R¹ and R² are alkyl radicals in which, in addition, one ("alkoxy" or "oxaalkyl") or two ("alkoxylalkoxy" or "dioxaalkyl") non-adjacent CH₂ groups may be replaced by O atoms, they can be straight-chain or branched. They are preferably straight-chain, have 2, 3, 4, 5, 6 or 7 C atoms and are accordingly preferably ethyl, propyl, butyl, pentyl, hexyl, heptyl, ethoxy, propoxy, butoxy, pentoxy, hexoxy or heptoxy,

furthermore methyl, octyl, nonyl, decyl, undecyl, dodecyl, tridecyl, tetradecyl, pentadecyl, methoxy, octoxy, nonoxy, decoxy, undecoxy, dodecoxy, tridecoxy or tetradecoxy.

5 Oxaalkyl is preferably straight-chain 2-oxapropyl (= methoxymethyl), 2- (= ethoxymethyl) or 3-oxabutyl (= 2-methoxyethyl), 2-, 3- or 4-oxapentyl, 2-, 3-, 4- or 5-oxahexyl, 2-, 3-, 4-, 5- or 6-oxaheptyl, 2-, 3-, 4-, 5-, 6- or 7-oxaoctyl, 2-, 3-, 4-, 5-, 6-, 7- or 8-oxanonyl, 2-, 3-, 4-, 5-, 6-, 7- or 2,4-dioxapentyl, 1,3-, 1,4-, 1,5-, 2,4-, 2,5- or 3,5-dioxahexyl, or 1,3-, 1,4-, 1,5-, 1,6-, 2,4-, 2,5-, 2,6-, 3,5-, 3,6- or 4,6-dioxaheptyl.

15 If R¹ and R² are an alkyl radical in which one CH₂ group has been replaced by -CH=CH-, the trans form is preferred. This alkenyl radical can be straight-chain or branched. It is preferably straight-chain and has 2-10 C atoms. It is accordingly particularly vinyl, prop-1- or -2-enyl, but-1-, -2- or -3-enyl, pent-1-, -2-, -3- or -4-enyl, hex-1-, -2-, -3-, -4- or -5-enyl, hept-1-, -2-, -3-, -4-, -5- or -6-enyl, oct-1-, -2-, -3-, -4-, -5-, -6- or -7-enyl, non-1-, -2-, -3-, -4-, -5-, -6-, -7- or -8-enyl, or dec-1-, -2-, -3-, -4-, -5-, -6-, -7-, -8- or -9-enyl.

25 Compounds of the formula I having branched wing groups R¹ and/or R² may occasionally be of importance due to better solubility in the customary liquid-crystalline base materials, but in particular as chiral dopes if they are optically active. Smectic compounds of this type are suitable as components for ferroelectric materials.

Branched groups of this type generally contain not more than one chain branch. Preferred branch radicals R¹ and/or R² are isopropyl, 2-butyl (= 1-methylpropyl), isobutyl (= 2-methylpropyl), 2-methylbutyl isopentyl (= 3-methylbutyl), 2-methylpentyl, 3-methylpentyl, 2-ethylhexyl, 2-propylpentyl, iso-
5 propoxy, 2-methylpropoxy, 2-methylbutoxy, 3-methylbutoxy, 2-methylpentoxy, 3-methylpentoxy, 2-ethylhexoxy, 1-methylhexoxy, 1-methylheptoxy, 2-oxa-3-methylbutyl, 3-oxy-4-methylpentyl, 4-methylhexyl, 2-nonyl, 2-decyl, 2-dodecyl and 6-methoxyloctoxy.
10

The formula I covers the racemates of these compounds and the optical antipodes, and mixtures thereof.

15 Of the compounds of the formulae I those are preferred in which at least one of the radicals present therein has one of the preferred meanings indicated.

20 The compounds of the formula I are prepared by methods which are known per se, as described in the literature (for example in the standard works such as Houben-Weyl, Methoden der Organischen Chemie [Methods of Organic Chemistry], Georg-Thieme-Verlag, Stuttgart), to be precise under reaction conditions which are known and suitable for the reactions mentioned. Use can also be made here of variants which are known per se, but are not described in greater detail here.
25

If desired, the starting materials can also be formed in situ by not isolating them from the reaction mixture, but instead immediately reacting them further to form the compounds of the formula I.
30

The compounds of the formula I can be prepared as indicated in the following scheme:

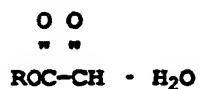
Scheme 1

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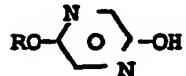
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1. Silver nitrate
2. Sodium acetate/DMSO
3. H_2O



Glycinamide hydrochloride
Base

15



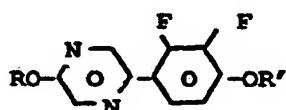
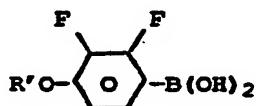
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POBr_3



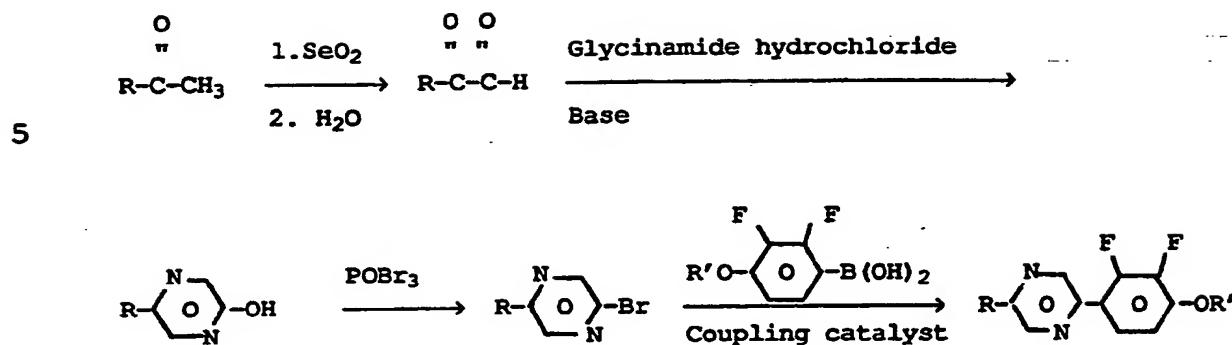
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coupling catalyst



30

Scheme 2



In addition to one or more compounds according to the invention, the liquid-crystalline media according to the invention preferably contain, as further components, 2 to 40, in particular 4 to 30, components. Besides one or more compounds according to the invention, these media very particularly preferably contain 7 to 25 components. These further components are preferably selected from nematic or nematogenic (monotropic or isotropic) substances, in particular substances from the classes of the azoxybenzenes, benzylideneanilines, biphenyls, terphenyls, phenyl or cyclohexyl benzoates, phenyl or cyclohexyl cyclohexanecarboxylates, phenyl or cyclohexyl cyclohexylbenzoates, phenyl or cyclohexyl cyclohexylcyclohexanecarboxylates, cyclohexylphenyl benzoate, cyclohexanecarboxylate and cyclohexylcyclohexanecarboxylate, phenyl-cyclohexanes, cyclohexylbiphenyls, phenylcyclohexylcyclohexanes, cyclohexylcyclohexanes, cyclohexylcyclohexenes, cyclohexylcyclohexylcyclohexenes, 1,4-bis-cyclohexylbenzenes,

4,4'-bis-cyclohexylbiphenyls, phenyl- or cyclohexylpyrimidines, phenyl- or cyclohexylpyridines, phenyl- or cyclohexyldioxanes, phenyl- or cyclohexyl-1,3-dithianes, 1,2-diphenylethanes, 1,2-dicyclohexylethylenes, 1-phenyl-2-cyclohexylethylenes, 1-cyclohexyl-2-(4-phenylcyclohexyl)ethanes, 1-cyclohexyl-2-biphenylethylenes, 1-phenyl-2-cyclohexylphenylethylenes, optionally halogenated stilbenes, benzyl phenyl ethers, tolans and substituted cinnamic acids. The 1,4-phenylene groups in these compounds may also be fluorinated.

10

The most important compounds which are suitable as further components of media according to the invention can be characterized by the formulae 1, 2, 3, 4 and 5:

15	R' -L-E-R''	1
	R' -L-COO-E-R''	2
	R' -L-OOC-E-R''	3
	R' -L-CH ₂ CH ₂ -E-R''	4
	R' -L-C≡C-E-R''	5

20

In formulae 1, 2, 3, 4 and 5, L and E, which may be identical or different and are in each case independent of one another, are a divalent radical from the group formed from -Phe-, -Cyc-, -Phe-Phe-, -Phe-Cyc-, -Cyc-Cyc-, -Pyr-, -Dio-, -G-Phe- and -G-Cyc- and the mirror images thereof, where Phe is unsubstituted or fluorine-substituted 1,4-phenylene, Cyc is trans-1,4-cyclohexylene or 1,4-cyclohexenylene, Pyr is pyrimidine-2,5-diyl or pyridine-2,5-diyl, Dio is 1,3-dioxane-2,5-diyl and G is 2-(trans-1,4-cyclohexyl)ethyl, pyrimidine-2,5-diyl, pyridine-2,5-diyl or 1,3-dioxane-2,5-diyl.

One of the radicals L and E is preferably Cyc, Phe or Pyr. E
is preferably Cyc, Phe or Phe-Cyc. The media according to the
invention preferably contain one or more components selected
from the compounds of the formulae 1, 2, 3, 4 and 5, in which
5 L and E are selected from the group comprising Cyc, Phe and
Pyr and simultaneously one or more components selected from
the compounds of the formulae 1, 2, 3, 4 and 5 in which one
of the radicals L and E is selected from the group comprising
Cyc, Phe and Pyr and the other radical is selected from the
group comprising -Phe-Phe-, -Phe-Cyc-, -Cyc-Cyc-, -G-Phe- and
-G-Cyc-, and, if appropriate, one or more components selected
from the compounds of the formulae 1, 2, 3, 4 and 5 in which
the radicals L and E are selected from the group comprising
-Phe-Cyc-, -Cyc-Cyc-, -G-Phe- and -G-Cyc.

15 In the compounds of the sub-formulae 1a, 2a, 3a, 4a and 5a,
R' and R'', in each case independently of one another, are
alkyl, alkenyl, alkoxy, alkenyloxy or alkanoyloxy having up
to 8 carbon atoms. In most of these compounds, R' and R'' are
20 different from one another, one of these radicals usually
being alkyl or alkenyl. In the compounds of the sub-formulae
1b, 2b, 3b, 4b and 5b, R'' is -CN, -CF₃, F, Cl or -NCS; in
these formulae, R has the meaning indicated in the case of
the compounds of the sub-formulae 1a to 5a and is preferably
25 alkyl or alkenyl. However, other variants of the proposed
substituents in the compounds of the formulae 1, 2, 3, 4 and
5 are common. Many such substances and also mixtures thereof
are commercially available. All these substances can be
obtained by methods known from the literature or analogously
30 thereto.

Besides components from the group comprising the compounds 1a, 2a, 3a, 4a and 5a (group 1), the media according to the invention preferably also contain components from the group comprising the compounds 1b, 2b, 3b, 4b and 5b (group 2), whose proportions are preferably as follows:

5 group 1: 20 to 90 %, in particular 30 to 90 %,
group 2: 10 to 80 %, in particular 10 to 50 %,

10 the sum of the proportions of the compounds according to the invention and of the compounds from groups 1 and 2 adding up to 100 %.

15 The media according to the invention preferably contain 1 to 40 %, in particular preferably 5 to 30 %, of compounds according to the invention. Additionally preferred media are those which contain more than 40 %, in particular 45 to 90 %, of compounds according to the invention. The media preferably contain three, four or five compounds according to the invention.

20 The media according to the invention are prepared in a manner customary per se. In general, the components are dissolved in one another, preferably at elevated temperature. By means of suitable additives, the liquid-crystalline phases according to the invention can be modified in a manner such that they can be used in all types of liquid-crystal display elements disclosed hitherto. Additives of this type are known to those skilled in the art and are described in detail in the literature (H. Kelker/R. Hatz, Handbook of Liquid Crystals, Verlag Chemie, Weinheim, 1980). For example, pleochroic dyes can be added for the preparation of colored guest/host systems, or

substances can be added to modify the dielectric anisotropy, the viscosity and/or the orientation of the nematic phases.

The examples below are intended to illustrate the invention without representing a limitation. mp. = melting point, cp. = clear point. Above and below, percentages are percent by weight; all temperatures are given in degree Celsius. "Customary work-up" means that water is added, the mixture is extracted with methylene chloride, the organic phase is separated off, dried and evaporated, and the product is purified by crystallization and/or chromatography.

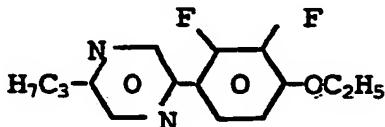
In addition, the abbreviations have the following meanings:

C: crystalline-solid state, S: smectic phase (the index characterizes the phase type), N: nematic state, Ch: cholesteric phase, I: isotropic phase. The number between two symbols indicates the conversion temperature in degree Celsius.

20

Example 1

25



Step 1.1

Propylmethylketone (0.059 mol) was added to a solution of selenium dioxide (0.059 mol) in 95 % ethanol which was then refluxed for 4 hours. After cooling the selenium was filtered

off and the solvent was removed under reduced pressure to yield a solid which was recrystallized from aqueous acetone to give a white solid.

5 Step 1.2

0.05 mol propylglyoxal hydrate was dissolved in methanol cooled to below -40 °C and then 0.05 mol dry powdered glycine-amide hydrochloride was added to the stirred solution. The 10 temperature was allowed to rise slowly to 30 °C and maintained at this temperature while NaOH (0.12 mol in 25 cm³ H₂O) was added dropwise. The reaction mixture was then maintained and stirred for 3 hours at -20-0 °C and 2 hours at 0-20 °C. After cooling to 0 °C the pH was adjusted to 5.0 with conc. HCl when 15 a precipitate was formed which was collected and washed with water purified by dissolving in aqueous NaOH and washing with dichloromethane and reprecipitating with HCl.

20 Step 1.3

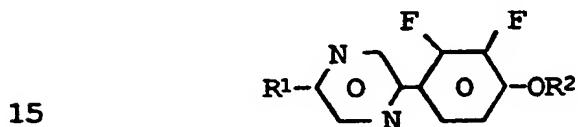
5-Propylpyrazin-2-ol (0.03 mol) and phosphorus pentabromide (0.03 mol) were heated together on an oil bath at 100 °C until evolution of HBr ceased. The residual POBr₃ was removed at 25 reduced pressure and the crude material purified by column chromatography.

30 Step 1.4

48.5 mmol of magnesium in 8 ml THF in slowly added under dry nitrogen to a mixture of 44.1 mmol 2,3-difluoro-1-bromo-4-ethoxy phenylene in 50 ml of THF. The Grignard reagent is

refluxed for a further hour, cooled in ice and 53.4 mmol of trimethylborate is added. After stirring overnight the borate ester is hydrolyzed with dilute HCl. The product is extracted into ether, dried and the solvent removed. 2-bromo-5-propyl-pyrazine (35 mmol), boronic acid (38.5 mmol) and Pd(PPh₃)₄ (4·10⁻⁴ mmol) are refluxed overnight under nitrogen, in a mixture of toluene (45 ml), aqueous Na₂CO₃ (20 ml) and 15 ml of ethanol. Customary work-up gives the desired pyrazine.

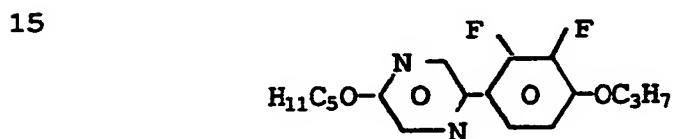
10 The following compounds of the formula are prepared analogously:



	R ¹	R ²
20	C ₂ H ₅	C ₂ H ₅
	C ₂ H ₅	n-C ₃ H ₇
	C ₂ H ₅	n-C ₅ H ₁₁
	C ₂ H ₅	n-C ₆ H ₁₃
	n-C ₃ H ₇	n-C ₃ H ₇
25	n-C ₃ H ₇	n-C ₅ H ₁₁
	n-C ₃ H ₇	n-C ₆ H ₁₃
	n-C ₅ H ₁₁	C ₂ H ₅
	n-C ₅ H ₁₁	n-C ₃ H ₇
	n-C ₅ H ₁₁	n-C ₅ H ₁₁
30	n-C ₅ H ₁₁	n-C ₆ H ₁₃

	R ¹	R ²
	n-C ₆ H ₁₃	C ₂ H ₅
	n-C ₆ H ₁₃	n-C ₃ H ₇
5	n-C ₆ H ₁₃	n-C ₅ H ₁₁
	n-C ₆ H ₁₃	n-C ₆ H ₁₃
	n-C ₉ H ₁₇	C ₂ H ₅
	n-C ₉ H ₁₇	n-C ₃ H ₇
10	n-C ₉ H ₁₇	n-C ₅ H ₁₁
	n-C ₉ H ₁₇	n-C ₆ H ₁₃

Example 2



Step 2.1

20

Silver nitrate (0.05 mol) was added to a solution of n-pentyl 1-bromoacetate (0.041 mol) in acetonitrile (80 ml). After stirring for 24 hours at room temperature the precipitate was filtered off and washed with ether. The washings and the 25 filtrate were combined and the solvent removed under reduced pressure. The residue was dissolved in ether, washed with water and dried (MgSO₄). The solvent was removed to yield a crude nitrate ester which was converted to pentoxyglyoxal without further purification.

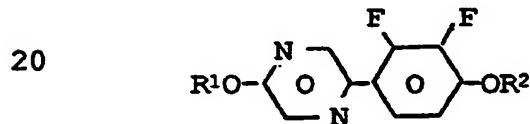
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Sodium acetate trihydrate (0.004 mol) was added to the crude nitrate ester dissolved in dimethylsulfoxide (150 ml) and stirred for 0.5 h at 20-25 °C. The reaction mixture was poured onto ice, the resulting solution was saturated with sodium chloride and was then extracted with ether. The combined organic extracts were washed with water, aqueous bicarbonate, dried ($MgSO_4$), the solvent removed and the crude glyoxal recrystallized.

10 Step 2.2

Steps 1.2 to 1.4 are repeated to obtain from pentoxyglyoxal by reaction with glycinamide hydrochloride, $POBr_3$ and then in the final coupling stage the desired 2,3-difluorophenylpyrazine derivative.

The following compounds of the formula



are prepared analogously

25	R^1	R^2
	C_2H_5	C_2H_5
	C_2H_5	$n-C_3H_7$
30	C_2H_5	$n-C_4H_9$
	C_2H_5	$n-C_5H_{11}$
	C_2H_5	$n-C_6H_{13}$

	n-C ₃ H ₇	C ₂ H ₅
	n-C ₃ H ₇	n-C ₃ H ₇
	n-C ₃ H ₇	n-C ₄ H ₉
	n-C ₃ H ₇	n-C ₅ H ₁₁
5	n-C ₃ H ₇	n-C ₆ H ₁₃
	n-C ₄ H ₇	C ₂ H ₅
	n-C ₄ H ₉	n-C ₃ H ₇
	n-C ₄ H ₉	n-C ₄ H ₉
10	n-C ₄ H ₉	n-C ₅ H ₁₁
	n-C ₄ H ₉	n-C ₆ H ₁₃
	n-C ₅ H ₁₁	C ₂ H ₅
	n-C ₅ H ₁₁	n-C ₄ H ₉
	n-C ₅ H ₁₁	n-C ₅ H ₁₁
15	n-C ₅ H ₁₁	n-C ₆ H ₁₃
	n-C ₆ H ₁₃	C ₂ H ₅
	n-C ₆ H ₁₃	n-C ₃ H ₇
	n-C ₆ H ₁₃	n-C ₄ H ₉
20	n-C ₆ H ₁₃	n-C ₅ H ₁₁
	n-C ₆ H ₁₃	n-C ₆ H ₁₃

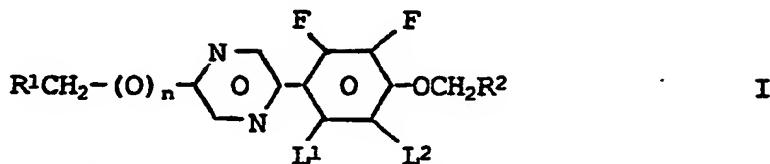
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C l a i m s

1. Phenylpyrazine derivatives of the formula I

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wherein

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R^1 and R^2 are in each case independently of each other, an unsubstituted alkyl or alkenyl radical or an alkyl or alkenyl radical substituted by one or more halogen or CN atoms having up to 15 C atoms, wherein one or two non-adjacent CH_2 groups can also be replaced by $-O-$ and/or $-CO-$ groups and/or $-O-CO-$ groups and/or $-CO-O-$ groups and/or $-CH-$ halogen groups,

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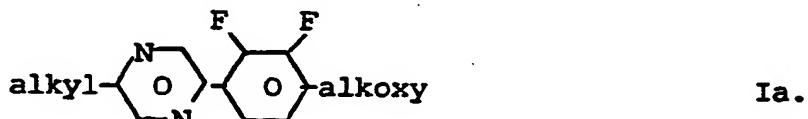
n 0 or 1, and

L^1 and L^2 are each independently of one another H or F.

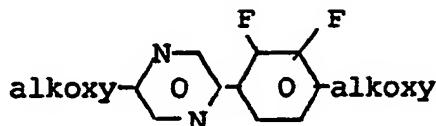
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2. Phenylpyrazines of the formula Ia,

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3. Phenylpyrazines of the formula Ib,



4. Use of the compounds of the formula I according to
Claim 1 as components of liquid-crystalline media.

10 5. Liquid-crystalline medium containing at least two liquid-
crystalline components, characterized in that at least
one component is a compound of the formula I.

15 6. Liquid crystal display element, characterized in that it
contains a medium according to Claim 5.

7. Electro-optical display element according to Claim 4,
characterized in that it contains as dielectric a medium
according to Claim 5.

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Relevant Technical Fields

(i) UK Cl (Ed.L) C2C
(ii) Int Cl (Ed.5) C07D

Databases (see below)

(i) UK Patent Office collections of GB, EP, WO and US patent specifications.

(ii) ONLINE DATABASE: CAS ONLINE

Search Examiner
S J QUICK

Date of completion of Search
21 OCTOBER 1993

Documents considered relevant
following a search in respect of
Claims :-
1-7

Categories of documents

- X: Document indicating lack of novelty or of inventive step.
Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.
A: Document indicating technological background and/or state of the art.

- P: Document published on or after the declared priority date but before the filing date of the present application.
E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.
&: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages	Relevant to claim(s)
	No documents found	

Databases: The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journal (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents).

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